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A SECOND SKINK WITH FRAGMENTED HEAD SCALES FROM BOUGAINVILLE, SOLOMON ISLANDS

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One of the most unusual skinks to come out of the Solomon Islands is *Sphenomorphus taylori* from the island of Bougainville. At the time of its description (Burt, 1930; based on 2 individuals from "Bougainville") the species was unique among skinks in having many of the normally large and symmetrical head scales broken up into a less ordered array of smaller scales (Fig. 3; fig. 21 in Burt and Burt, 1932). Eight more specimens of this species recently collected by Parker on Bougainville confirm that the fragmentation of the head scales is the normal condition for the species.

During the same collecting efforts that yielded *S. taylori*, seven individuals of an as yet undescribed species of skink were taken by Parker on Bougainville. Among the distinctive features of this new species is the rather symmetrical fragmentation of the head scales on the dorsal and lateral surfaces of the snout.

Although the presence of a supranasal scale would place the new species in either the genus *Otosaurus* or *Parotosaurus* in any of the most recent classifications of lygosomine skinks (Boulenger, 1887; M. A. Smith, 1937; Mittleman, 1952), recent work (by Greer; see Greer and Parker, 1967) on skink systematics indicates that these genera (along with the monotypic *Insulasaurus*) are not readily separable from a large group of *Sphenomorphus* (also see Burt and Burt, 1932: 542). Until the systematics of this group is better understood, we choose to reject the names *Otosaurus*, *Parotosaurus* and *Insulasaurus* in favor of *Sphenomorphus*.

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The new species may therefore be known as:

SPHENOMORPHUS FRAGOSUS new species¹

Holotype (Fig. 1): Museum of Comparative Zoology 92265, collected by Fred Parker on 31 March 1966 at Lake Loloru (elev. 4300 feet), Bougainville, Solomon Islands.

Paratypes: Mutahi area (4000 feet), Bougainville: MCZ 92268, coll. 13 May 1966. Lake Loloru: MCZ 92262-92264, 92266-92267, same data as holotype.

Diagnosis: *S. fragosus* is a member of the *variegatus* species group (Greer and Parker, 1967), which is characterized by the presence of a large or small supranasal, and/or a double anterior loreal (although some species lack supranasals and have only a single anterior loreal); usually 5 or more supraoculars of which usually 3 or more are in contact with the frontal; digits and limbs well developed and generally overlapping broadly when adpressed to the body; and the absence of transversely enlarged vertebral scales, i.e., the middorsal scales are subequal in size.

The *variegatus* species group includes all the species previously referred to the genera *Otosaurus*, *Parotosaurus* and *Insulasaurus* as well as part of the genus *Sphenomorphus*. Those species of the *variegatus* species group with a supranasal and/or double anterior loreal are as follows: *amblyplacodes*, *annectens*, *anomalopus*, *celebense*, *concinatus*, *cumingi*, *curtirostris*, *cyanolaemus*, *darlingtoni*, *granulatus*, *haasi*, *jobiense*, *kinabaluensis*, *maculicollus*, *mimikanus*, *multisquamulatus*, *murudensis*, *nigrolabris*, *sabanus*, *sarasinorous*, *simus*, *stickeli*, *taylori*, *totocarinatus*, *tropidonotus*, *variegatus*, *wrighti*. Those members of the *variegatus* species group lacking both a supranasal and double anterior loreal are: *aignanus*, *arborens*, *boulengeri*, *dussumieri*, *florense*, *formosensis*, *indicus*, *kühnei*, *lineopunctulatus*, *maculatus*, *melanochlorus*, *milnense*, *misolense*, *sanctus*, *striolatus*.²

S. fragosus can be easily distinguished from other species of its species group by means of the small symmetrical scales on the

¹ The species name calls attention to the rather symmetrical fragmentation of the head scales on the dorsal and lateral regions of the snout.

² The *variegatus* species group is distributed from southeast Asia and the Greater Sunda Islands northeast to the Philippines and east through Celebes and the Lesser Sunda Islands to New Guinea and the Solomon Islands. The group is not found in Australia, however. The center of abundance for the group appears to be the western part of the Indo-Australian archipelago and, perhaps to a lesser extent, New Guinea.

dorsal and lateral surfaces of the snout (Fig. 1). In this more or less symmetrical fragmentation of the scales of the snout, *S. fragosus* is unique among lygosomine skinks with the exception of the much larger *S. taylori*, also from Bougainville (for other differences between the two species, see Table 1).

Description: Body brownish above and in form tending toward stockiness; snout obtusely rounded and deep; limbs pentadactyl, well developed and overlapping when adpressed to the body (tip of 4th toe to forearm); snout-vent length of seven known specimens from 31-73 mm.

Rostral as deep as wide, projecting only slightly onto dorsal surface of snout; nostril in a single nasal; nasal bordered ventrally by the first supralabial, anteriorly by the rostral, dorsally by a thin supranasal, which touches the rostral, and posteriorly by 2 superposed anterior loreals, the upper of which contacts the supranasal; a small frontonasal is bordered anteriorly by the rostral and laterally by the supranasals; posteriorly the frontonasal is followed by a pair of small scales, and either a single small median scale and another pair of small scales, or simply by a single median scale; these small scales on the dorsal area of the snout separate the frontals (Fig. 1).

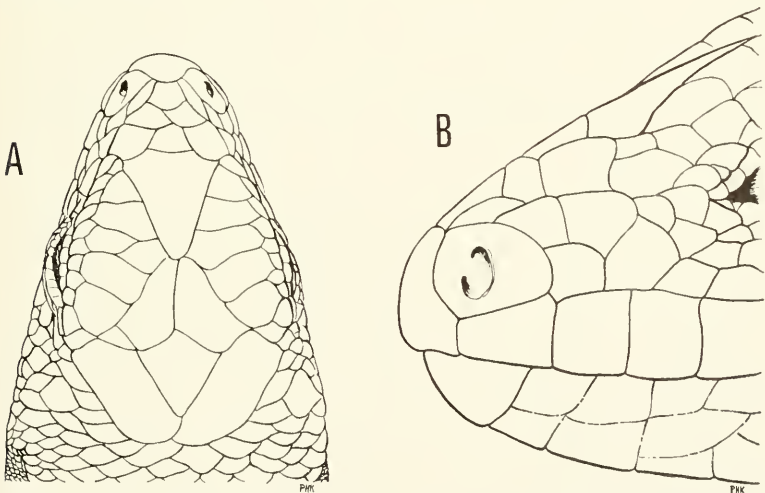


Figure 1. Holotype (Museum of Comparative Zoology 92265) of *Sphenomorphus fragosus*. A) Dorsal view of head. B) Lateral view of the left side of the snout anterior to the eye.

Frontal scale contacts the last small scale or pair of scales of the snout; the 2 superposed anterior loreals are followed by a superposed pair of posterior loreals which are directly below the prefrontal; 5 supraoculars, the 3 anteriormost supraoculars in contact with the frontal; frontoparietals and interparietal distinct; parietals meet behind interparietal; no nuchals; lower eyelid scaly, separated from supralabials by a complete row of subocular scales; 5th and 6th supralabials, or, less frequently, just 6th supralabial below eye; ear opening vertically elliptic, without lobules, and approximately equal in size to eye opening.

Scales in 42-46 longitudinal rows at midbody; dorsal body scales subequal, i.e., vertebral scales not transversely enlarged; a pair of enlarged preanal scales; 3 median series of subcaudal scales subequal in size; 4th (longest) toe with 18-21 laterally keeled subdigital lamellae; upper surface of 4th toe covered by 1 or 2 scale rows distally, 3 scale rows along the mid-section and 4-5 scale rows basally (most similar to Group V of Brongersma, 1942).

Color: In preserved specimens the upper surface of the head and body is brown with a series of more or less transversely confluent dark brown to black spots on the body which may be confined to the midline or, less frequently, extend the width of the brown dorsal area. The brown dorsum is bordered laterally by a black dorsolateral band, which is distinct but not sharply demarcated, and extends from the posterior corner of the eye to the base of the tail. The upper part of this black dorsolateral band is bordered by thin longitudinal streaks of white which tend to be more confluent and well defined in the area just above and posterior to the shoulder.

Below the black dorsolateral band the sides of the neck and body are grayish brown and, in some specimens, sporadically spotted with whitish flecks. The gray-brown of the sides fades to gray-white on the venter. The venter from the chin onto the tail is grayish white (yellow in life) and may be spotted with black.

The upper surfaces of the limbs are brown but heavily spotted with black, and the lower surfaces are white and lightly spotted with black.

The color pattern of the tail vaguely reflects the body pattern, i.e., brown middorsally with a series of dark brown to black spots dorsolaterally below which a gray ground color gives way to a gray-white venter. The regenerated tail is light reddish brown and generally unpatterned.

In juveniles the dorsum is a lighter golden brown which accentuates the dark dorsal spots and the dark sides.

Distribution (Fig. 2): The seven known specimens of *S. fragosus* are from between 4000-4300 feet, in the central highlands of Bougainville. Six specimens were taken in southcentral Bougainville (Lake Loloru, 4300 feet) and the seventh was collected in northeastern Bougainville (near Mutahi, 4000 feet). The 2 localities are approximately 70 miles apart.

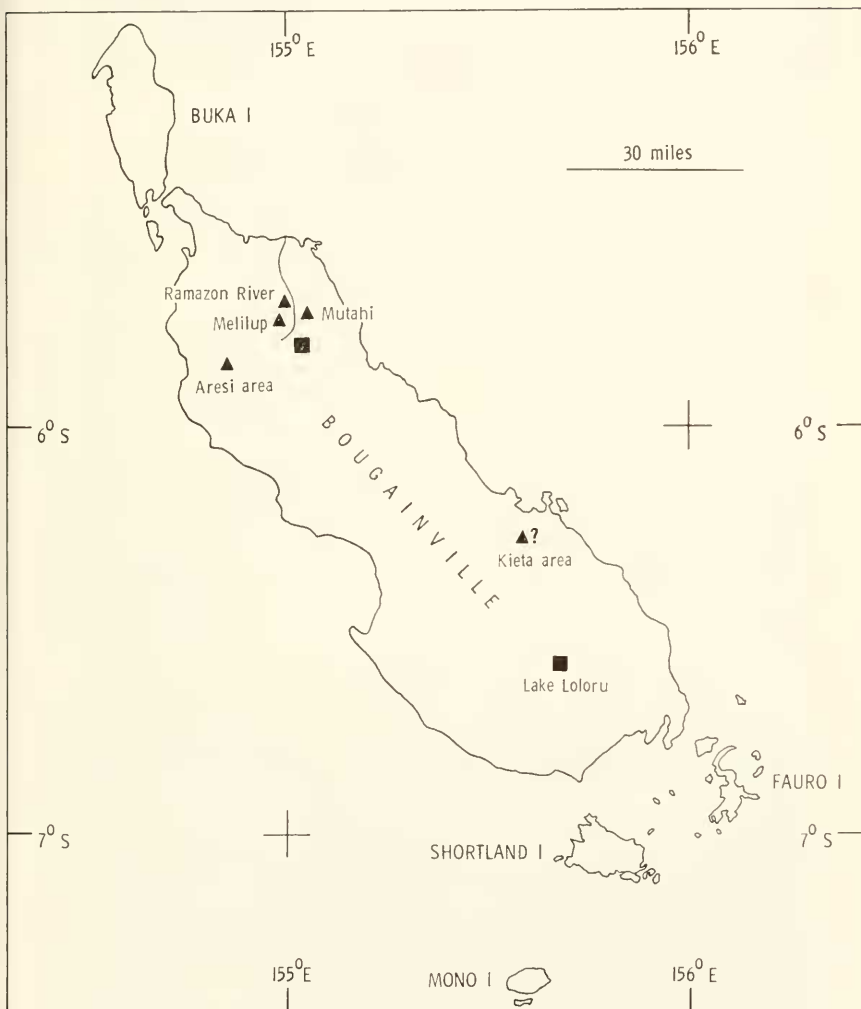


Figure 2. Map of Bougainville, Solomon Islands, showing the known collecting localities for *Sphenomorphus fragosus* (squares) and *S. taylori* (triangles).

Variation: The six specimens from southcentral Bougainville have 42(3), 43(1), 44(1), or 46(1) longitudinal scale rows around midbody. The single specimen from northeast Bougainville has 46 scales around midbody.

The color pattern of the individual from northeast Bougainville differs from the patterns of the specimens from the southcentral part of the island in that the black dorsolateral band becomes less distinct on the posterior half of the body and the light throat and chest are reticulated with black. In addition there is a dark mid-ventral line.

MORPHOLOGICAL COMPARISONS WITH RELATIVES ON BOUGAINVILLE

The only species of *S. fragosus*' species group (see Diagnosis) on Bougainville, or in the Solomon Islands, for that matter, are *S. concinnatus* and *S. taylori*. The three species are readily distinguished by the characters given in Table 1.

S. concinnatus is widely distributed throughout the Solomon Islands from Buka Island in the northwest to Guadalcanal in the southeast. Specimens from Bougainville and neighboring islands (e.g., Buka and some of the islands in Bougainville Straits) show a good deal of inter- and intra-population variation in squamation and color pattern, indicating that the systematics of the species in the Solomons is probably not as straightforward as the simple binomial would indicate. A discussion of the variation of the species on Bougainville and in other parts of the Solomons will be the object of a separate study. The data given in Table 1 for *S. concinnatus* were obtained from 60 specimens collected at Mutahi (2200-3200 feet elev.). Bougainville.

To date, *S. taylori* (Fig. 3) has been known in the literature from only the two type specimens discussed in the original description (Burt, 1930). Parker, however, has recently obtained 8 more specimens of this species from the following localities on Bougainville (Fig. 2): Aresi area (1 specimen, 2500 feet); Kieta area (1 specimen, no exact locality data); Melilup (2 specimens, 3000 feet); Mutahi (3 specimens, 2200-3200 feet); Ramazon River (1 specimen, 1600-2400 feet). Data from these specimens are combined in Table 1 with the data from the original description of the species.

The color patterns of the three species are distinctive and immediately diagnostic. *S. concinnatus* shows some geographic and altitudinal variation in pigmentation and color pattern with specimens from the highlands of Bougainville most closely resembling

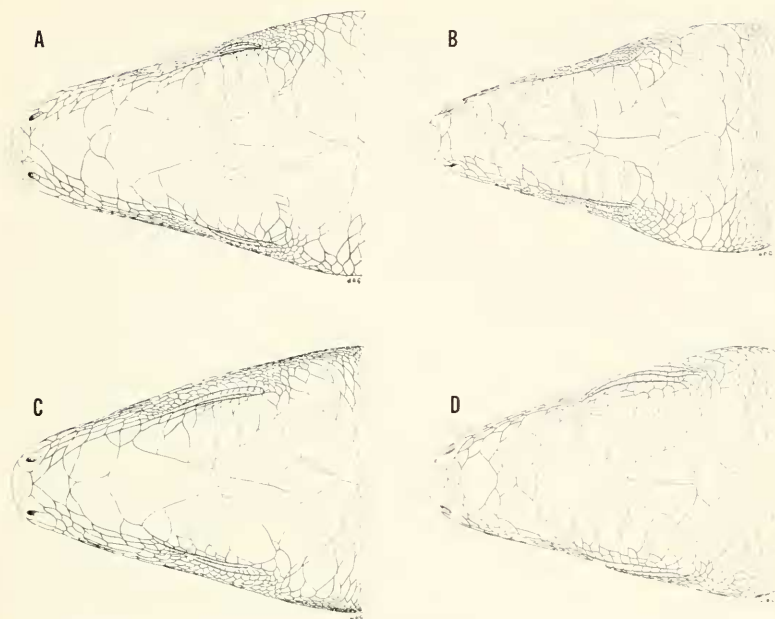


Figure 3. Dorsal view of the head of 4 specimens of *Sphenomorphus taylori*. A) Holotype, American Museum of Natural History 42018 from "Bougainville." B) Museum of Comparative Zoology 65857 from Kieta area. C) Paratype, American Museum of Natural History 42016 from "Bougainville." D) Museum of Comparative Zoology 78090 from Aresi area (2500 feet).

S. fragosus. *S. concinnatus* from Mutahi (2200-3200 feet), for example, are as dark dorsally as *S. fragosus*, whereas *S. concinnatus* from many lowland areas of Bougainville, as well as the small off-shore islands, are generally a much lighter golden brown dorsally.

The highland *S. concinnatus* also tend to show a middorsal series of dark brown to black blotches somewhat similar to those of *S. fragosus*. In addition there is a diffuse series of small dark blotches along the dorsolateral line of highland *S. concinnatus* which is generally lacking or is much less well defined in the populations from the lowlands of Bougainville and the off-shore islands. Each of these dark blotches along the dorsolateral line of highland *S. concinnatus* is often associated with a small whitish spot situated anterior to and just above the dark blotch.

This dorsolateral series of dark and light blotches in *S. concinnatus* is rather similar to the continuous, dark dorsolateral line with its associated light line in *S. fragosus*. One might think of the *S. fragosus* pattern as originating from the fusion (into a continuous line) of the distinct blotches in *S. concinnatus*, or, vice versa, the formation of the distinct blotches in *S. concinnatus* from the fragmentation of the continuous line in *S. fragosus*.

S. concinnatus differs rather strikingly from *S. fragosus* in displaying a large black spot between the external ear opening and the point of insertion of the forelimb. This black spot is totally lacking in *S. fragosus*. Furthermore, in life, *S. concinnatus* lacks the yellow ventral coloring of *S. fragosus*.

Juvenile and young adult *S. taylori* are quite unlike either of the species' two Bougainville relatives in displaying a color pattern of light transverse bars on the dark brown mid-dorsum. The flanks are a lighter grayish brown to beige with faint white spots which may coalesce to form distinct vertical light lines. In large adults all indications of the transverse and vertical bars may have vanished.

OSTEOLOGICAL COMPARISONS WITH BOUGAINVILLE RELATIVES

Single skulls have been prepared of *S. fragosus*, *S. concinnatus* and *S. taylori*.

Those features of the skull osteology that are characteristic of the *variegatus* species group to which the three species belong (see Diagnosis) are as follows: skull fairly deep throughout much of its length; 9 teeth on the premaxillae; palatine bones and palatal rami of the pterygoid bones meet along the midline to form an extensive secondary palate; no ectopterygoid process to the palatine which would exclude the palatal ramus of the pterygoid from a position on the infraorbital vacuity; postorbital bone lacking; supratemporal fenestra small or absent, in the latter case being obliterated by the backward extension of the postfrontal between the squamosal and parietal bones.

Differences between the skulls of *S. fragosus*, *S. concinnatus* and *S. taylori* are minor except for the shape of the teeth on the anterior part of the maxillae and dentaries in *S. taylori*. In this species the anterior maxillary and dentary teeth are slightly pointed and curved posteriorly, whereas the corresponding teeth in *S. fragosus* and *S. concinnatus*, as well as in other members of the *variegatus* species group that have been examined, are straighter and more peg-like.

The more pointed anterior maxillary and dentary teeth of *S. taylori* may be indicative of a shift to slightly more predaceous habits than either of its two Bougainville relatives.

S. taylori also differs from both *S. concinnatus* and *S. fragosus* in that the frontal bone forms a surface suture with the maxilla to separate the prefrontal and nasal bones, whereas in *S. concinnatus* and *S. fragosus* the prefrontal makes contact with the nasal through a finger-like anterior projection.

ECOLOGICAL COMPARISONS WITH RELATIVES ON BOUGAINVILLE

Of the three species of the *variegatus* species group on Bougainville, very little is known about the ecology and habits of *S. taylori* or *S. fragosus*. The ecology and habits of *S. concinnatus* are, however, somewhat better known.

S. concinnatus is a common species on Bougainville from the coast to about 4000 feet, although it is occasionally found to an altitude of at least 5000 feet. The species inhabits dense primary forest and shows a marked preference for moisture. Although normally crepuscular, it is found in the open by day during rain and on damp overcast days. Only very rarely are individuals seen basking in small patches of weak sun. The species is not a burrower but lives in leaf litter on the forest floor.

S. taylori is almost certainly a montane species, having been collected between 1600-3000 feet. Native collectors have obtained all the MCZ specimens, and where collectors could recall, the specimens were found under and beside decayed logs on the forest floor. The species does not seem to be a true burrower, however.

S. fragosus has been collected between 4000-4300 feet in the central highlands of Bougainville. The specimens were under moss and fallen *Pandanus* leaves on the ground in fairly open areas. None were found out in the open in spite of the fact that both days on which the species was collected were dull and overcast.

S. concinnatus is by far the most widespread and numerous of the three species of the *variegatus* species group on Bougainville. It is the only species of the three known to occur in the lowlands, where it is very common, and it extends through the known altitudinal range of its two relatives (1600-4300 feet) to an elevation of at least 5000 feet. Furthermore, *S. concinnatus* is the only one of the three species known to occur sympatrically with the other two. *S. fragosus* and *S. taylori* have never been found in the same area, although, admittedly, this may be a result of sampling error in populations of low density.

Although only the low and middle (0-5000 feet) elevations of Bougainville have been adequately collected, it would appear that *S. fragosus* and *S. taylori* do, in fact, occur in less dense populations than other Bougainville skinks (e.g., *S. concinnatus*, *S. solomonis* and *S. tanneri*) at these elevations. Thousands of reptiles and amphibians have been obtained by Parker and his collectors in all kinds of accessible habitats on Bougainville, and it is unlikely that animals as large or larger than these abundant skinks should not come to light in numbers approximately proportional to their relative frequency in the whole fauna.

The possibility can not be excluded, however, that *S. fragosus* and *S. taylori* may occur in very peculiar habitats that were not widely sampled during the general collecting, or that both species occur in much higher population densities at elevations above those collected.

Nothing is known of the mode of reproduction of *S. fragosus* or *S. taylori*, although *S. concinnatus* is live-bearing. Thirty gravid *S. concinnatus* from Kunua, Bougainville, contained 1-3 oviducal eggs or embryos in various stages of development. The snout-vent lengths of these 30 females ranged from 54-64 mm, and all were collected in the period May-June.

EVOLUTIONARY HISTORY OF THE SKINKS OF THE *VARIEGATUS* SPECIES GROUP ON BOUGAINVILLE

Within the *variegatus* species group, *S. concinnatus*, *S. fragosus* and *S. taylori* are most likely each other's closest living relatives.

S. concinnatus and *S. fragosus* are more similar to each other in overall external morphology, skull osteology, and color pattern than is any other skink of the *variegatus* species group to either one of them. Furthermore, the fact that two such similar species occur together on Bougainville and not one on Bougainville and the other on Celebes, for example, lends support to the hypothesis of their close relationship.

If it can be admitted that within the *variegatus* species group the fragmentation of the head scales as in *S. fragosus* is a specialization and the low supraocular number (4 as opposed to the more usual 5 or more) of *S. concinnatus* is primitive, then an animal similar to *S. concinnatus* can easily be conceived of as being ancestral to *S. fragosus*.

The evidence for the close relationship between *S. fragosus* and *S. taylori* rests primarily on the peculiar fragmentation of many corresponding head scales. The fact that among skinks this fragmentation is unique to two species of the same species group on the

same small island minimizes the possibility of convergence as an explanation.

The large body size, the high number of midbody scales, and the slightly pointed anterior maxillary and dentary teeth of *S. taylori* must again be viewed as specializations for the *variegatus* species group, derivable, perhaps, from a stock similar to present-day *S. fragosus*.

The structural changes in the evolution of the three species of the *variegatus* species group presently known from the Solomons may have proceeded along the general lines suggested by the sequence of living species: *S. concinnatus* → *S. fragosus* → *S. taylori*.

The ancestor of these three living species would have undoubtedly been recognized as an *Otosaurus* or *Parotosaurus* by Boulenger (1887), Smith (1937) or Mittleman (1952) and simply as a member of the *variegatus* species group by us. This ancestor most likely arrived in the Solomons from New Guinea or the Bismarck Archipelago, as the *variegatus* species group is unknown from Australia or the islands to the north, east or south of the Solomons.

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TABLE 1

Morphological comparisons between *Sphenomorphus fragosus* and the 2 members of its species group on Bougainville.

	<i>fragosus</i>	<i>concinatus</i>	<i>taylori</i>
Snout-vent length	31-73 mm	26-70 mm	59-160 mm
Scales around midbody	42-46	38-46	53-60
Number of supra-oculars (touching frontal)	5 (3)	4 (2)	5-7 (3)
Supralabials below orbit	5th and 6th, less often just 6th	5th, rarely 6th	6th - 9th, although variable
Subdigital lamellae (4th toe)	18-21	18-27, usually 19-23	27-35
Nuchal scales	None	None	1-2 pairs, ill-defined